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BULLETIN 264

JANUARY, 1925

Connecticut Agricultural Experiment Station
New Haven, Connecticut

Report of the Director
For the
Year Ending October 31, 1924

The Bulletins of this Station are mailed free to citizens of Connecticut who apply for them, and to other applicants as far as the editions permit.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION
OFFICERS AND STAFF
As of
October 31, 1924.

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A. E. MOSS, M.F., *Assistant Forester.*
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P. C. MANGELSDORF, M.S., *Graduate Assistant.*

Soil Research. M. F. MORGAN, M.S., *Investigator.*

Tobacco Sub-station at Windsor _____, *In Charge.*
N. T. NELSON, PH.D., *Plant Physiologist*

Report of the Director

FOR THE YEAR ENDING OCTOBER 31, 1924.

To the Board of Control of the Connecticut Agricultural Experiment Station:

The year under review has been one of satisfactory progress. Detailed reports on all departmental work are presented in later pages. Here follows a very brief mention of the most outstanding accomplishments of the year.

“DEFENSE” (CONTROL) WORK.

In protecting the people of the State by analyzing fertilizers, foods, drugs and insecticides, the analytical laboratory renders one



Fig. 1. Gipsy Moth Control—Creosoting Egg Mass.

of the most valuable services that the Station offers. Although not spectacular the work of the chemist is a highly important factor in the agricultural life of the State and in the protection of public health. In 1924, 880 samples of fertilizers, 352 samples of feeding stuffs and 1,800 samples of foods and drugs were examined in addition to many other materials collected or submitted.

Seed testing is an important project of the Botany department as is also the plant disease survey, which aims to discover any new or old diseases as soon as they appear within our boundaries.

The State entomologist, who is also the Station entomologist, is responsible for all work pertaining to insect pests. He has been able to prevent damage by the Gipsy Moth and predicts that,



Fig. 2. Burning Weeds and Rubbish that might harbor the European Corn Borer.

within a few years, liberated parasites will automatically hold this pest in check. Like the botanist, he attempts to scout the State constantly for new insects or outbreaks of old, thus giving the citizen warning and protection. The latest invasion is by the European Corn Borer which we hope to control at the outset.

THE VEGETABLE PROTEINS.

For many years Dr. Osborne and his associates have intensively studied the nature of these complex substances and many contributions to our knowledge of their nutritive value have resulted. In collaboration with Dr. L. B. Mendel and other members of the Yale faculty, studies are now being conducted on the effect of

various diets on growth, reproduction and on the occurrence of rickets.

Rickets in rats can be induced or cured at will by suitable adjustment in the diet. This study is important not only in relation to rickets in children but to leg weakness in chickens, for it has recently been demonstrated that this poultry disease is a form of rickets which can be cured by the same methods demonstrated to be successful on the albino rat.

It has heretofore been thought that too much protein in the ration injures the kidney. This, however, has not been confirmed by the experimental feeding of rats within the periods of time thus far studied. The kidneys, although enlarged, are not otherwise abnormal.

It has also been found that a diet may be entirely adequate for vigorous growth over long periods, but still be deficient in some factor which determines fertility. This fact may become important in the feeding of farm animals since it may later be discovered that the feeding of highly concentrated rations to high bred stock may be responsible for their lack of fertility.

In connection with this brief summary of biochemical investigations mention must be made of the development of methods for preparing pure protein substances in large quantities which has been the basis of past experimentation. In feeding these products to animals it has been shown conclusively that some proteins are inadequate for proper growth and development, while others possessing known or unknown characteristics are amply sufficient. The ability to prepare large amounts of pure proteins provides a sure foundation for further investigation in this field.

SPRAYING VS. DUSTING.

In recent years there has been considerable controversy on the merits of the two methods. Experiments begun in 1920 have failed to show any sound reason for abandoning the spray programs. A combination of dust and spray applications did not give great promise in 1924, but will be continued.

ROOT AND EAR ROTS OF SWEET CORN.

Steady progress is being made in developing disease-free seed by selection, the selected strain yielding 173 bushels as against 154 for the unselected seed. In the selected seed the per cent of disease has fallen from 51 to 18 in four years.

THE CHEMISTRY OF SPRAY MIXTURES.

In spite of our long experience with sprays, much is yet to be learned, especially because of the frequent addition of new materials to the mixtures. The Entomology department is engaged in a detailed study of this whole problem.

THE CABBAGE MAGGOT.

The control of this pest is still a problem. A new mode of attack involves the use of traps with proper baits, the problem being to find the aromatic substance in cabbage which seems to attract the moth.



Fig. 3. White Pines at Rainbow. Planted 1905.

THE EXPERIMENTAL FOREST AT RAINBOW.

Begun in 1902, these experimental plantations have now reached an age to yield valuable information. Plantings of hardwoods, with the exception of red oak, black walnut and chestnut, have failed on the coarse sand which covers the Rainbow plain. Of the conifers, the white, red and Scotch pine have made the most notable growth. It is yet too early, however, to recommend Scotch pine since it is a new type in this country.

BREEDING BETTER CORN.

One of the notable achievements of the Station in plant breeding has been the production of a new kind of sweet corn for canners and market gardeners. By continuous self-fertilization, the corn of two different strains was reduced to a state of great purity but little vigor. To reattain vigor these two purified strains were crossed and the new corn produced.

Because of the reddish color of the leaves the corn has been named Red Evergreen. It was tested in Ontario in 1923-24 and produced six tons of ears per acre in comparison with a standard variety of Evergreen which produced only three and one half tons.

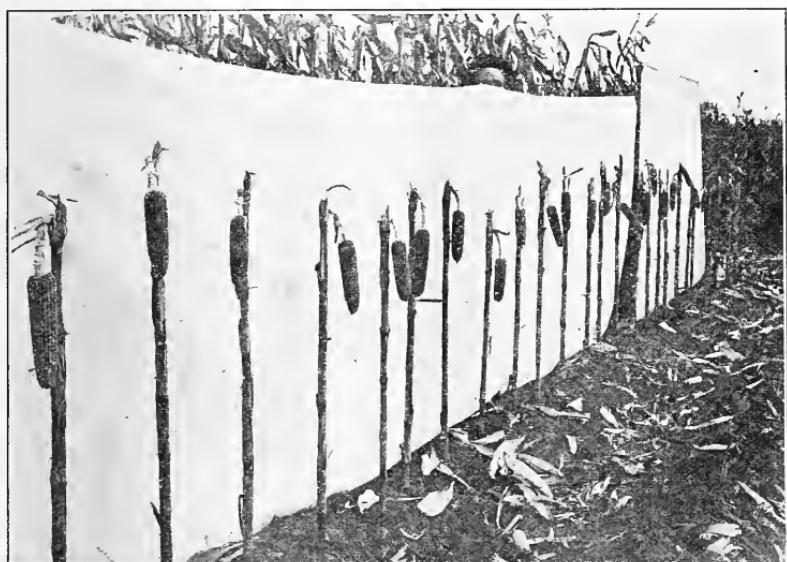


Fig. 4. Corn Produced from a Cross of Inbred Strains.—A perfect ear on every stalk.

The new corn has also been tested by several market gardeners in Connecticut and by canners in New York state with favorable results.

The method by which this corn was produced (selection in a self-fertilized line and crossing of fixed inbred strains) will be applied to other standard varieties of sweet corn.

SOILS OF CONNECTICUT.

A complete knowledge of our soils must be the basis of an intelligent use of our land resources. Soil surveys of Connecticut land were begun in 1923, two towns being carefully mapped. In 1924

six areas were added and a new laboratory equipped to study the nature of each of the important soil types identified. The possible results of this work are far-reaching. The farmer who has been on the land for a generation knows his soil, but to bring together widely scattered and diverse information by means of a survey must be the task of the soil scientist. Once this is accomplished, we have not only a sound basis for land utilization and taxation but a better knowledge of how to treat those areas which are intensively planted in tobacco or vegetables.

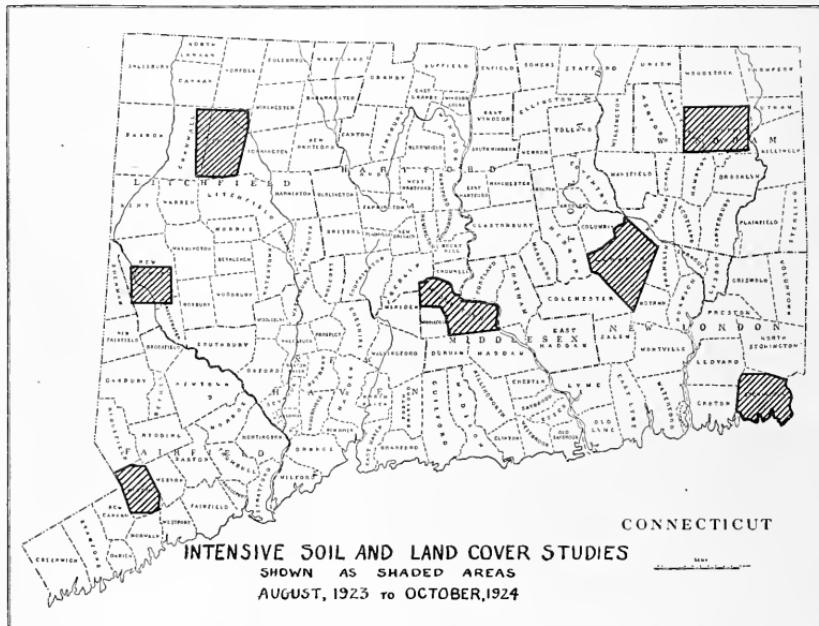


Fig. 5. Progress of the Soil Survey.

Mt. CARMEL FARM FIELD DAY.

The annual Station Field Day was held on August 11. This coincided with the field trip of the American Pomological Society and a joint program was held. President Charles L. Beach of the Connecticut Agricultural College gave the principal address.

CHANGES IN STAFF.

Appointments:

W. T. Mathis, Assistant Chemist, November 1, 1924.
 N. T. Nelson, Ph.D., Assistant in Plant Physiology at Tobacco Sub-Station, April 15, 1924.
 Roger B. Friend, B.S., Assistant Entomologist, Jan. 1, 1924.
 Willis R. Hunt, M. S., Assistant Botanist, July 1, 1924.

Resignations:

C. M. Slagg, M. S., in charge of Tobacco Sub-Station, March 31, 1924.



Fig. 6. Field Day at Mt. Carmel Farm, August, 1924.

PUBLICATIONS.

BULLETINS.

No. 250. Fertilizer Report for 1923.
 No. 251. The Raspberry Fruit Worm.
 No. 252. The European Red Mite.
 No. 253. Better Forests for Connecticut.
 No. 254. Report of the Director for the Year Ending October 31, 1923.
 No. 255. Report on Food Products and Drugs (1923).
 No. 256. Report of the State Entomologist (1923).
 No. 257. Report on Commercial Feeding Stuffs (1923).
 No. 258. Report on Insecticides and Fungicides (1923).
 No. 259. Corn in Connecticut.
 No. 260. Rust Infection of Leaves in Petri Dishes.

TOBACCO BULLETINS.

No. 4. Revised Recommendations for the Control of Wildfire.

CIRCULARS OF IMMEDIATE INFORMATION.

- No. 28. Winter Condition of Apple and Peach Buds.
- No. 29. Dormant Sprays for Orchard Pests.
- No. 30. Information About Insecticides and Fungicides.
- No. 31. Why and How to Spray.
- No. 32. Varietal Susceptibility of Apples to Diseases and Injuries.
- No. 33. The Prepink and Pink Sprays for Apples.
- No. 34. Spray for the Imported Current Worm.
- No. 35. Tree Workers Holding Connecticut Certificates.
- No. 36. The Calyx and Later Summer Sprays.
- No. 37. Peach Spraying.
- No. 38. Grape Spraying.
- No. 39. The Apple and Thorn Skeletonizer.
- No. 40. Spraying Shade Trees.
- No. 41. The Oriental Peach Moth.
- No. 42. Spraying Potatoes.
- No. 43. The Apple Maggot or Railroad Worm.
- No. 44. The Gipsy Moth Quarantine.
- No. 45. Sun Scorch, Anthracnose, etc. of Shade Trees.
- No. 46. Prematuring of Vegetables, Rots of Lettuce and Similar Troubles.
- No. 47. Prematuring and other Potato Troubles.

JOURNAL PAPERS.

Some Basic Substances from the Juice of the Alfalfa Plant.

By Charles S. Leavenworth, Alfred J. Wakeman and Thomas B. Osborne. *J. Biol. Chem.*, 1923, LVIII, 209-214.

Experimental Production of Rickets with Diets of Purified Food Substances.

By Thomas B. Osborne, Lafayette B. Mendel and Edwards A. Park. *Proc. Soc. Exper. Biol. and Med.*, 1923, XXI, 87-90.

The Effect of Diet on the Content of Vitamine B in the Liver.

By Thomas B. Osborne and Lafayette B. Mendel. *J. Biol. Chem.*, 1923, LVIII, 363-367.

Nutrition and Growth on Diets Highly Deficient or Entirely Lacking in Preformed Carbohydrates.

By Thomas B. Osborne and Lafayette B. Mendel. *J. Biol. Chem.*, 1924, LIX, 13-32.

Nutrition and Growth on Diets Highly Deficient or Entirely Lacking in Preformed Carbohydrates.

By Thomas B. Osborne and Lafayette B. Mendel. *Proc. Soc. Biol. Chem.*, *J. Biol. Chem.*, 1924, LIX, xliv.

Nutrition and Growth on Diets Highly Deficient or Entirely Lacking in Preformed Carbohydrates.

By Thomas B. Osborne and Lafayette B. Mendel. *Proc. Am. Physiol. Soc. Am. J. Physiol.*, 1924, LXVIII, 143.

The Nutritive Value of Lactalbumin.

By Thomas B. Osborne and Lafayette B. Mendel. *J. Biol. Chem.* 1924, LIX, 339-345.

The Vegetable Proteins, Second Edition.

By Thomas B. Osborne, Longmans, Green & Co., London, 1924, pp. xiii +154.

Ophthalmia as a Symptom of Dietary Deficiency.

By Thomas B. Osborne and Lafayette B. Mendel. *Am. J. Physiol.*, 1924, in press.

Evidence expérimentale du manque de vitamine dans l'alimentation.
By Lafayette B. Mendel. *Bull. Soc. Scient. d'Hyg. Alimentaire*, 1924, XII, 29.

Nutrition: The Chemistry of Life.
By Lafayette B. Mendel. *Yale University Press*, 1923, pp. xii +150.

Investigation on the Nitrogenous Metabolism of the Higher Plants.
V. Diurnal Variations in the Protein Nitrogen of Runner-Bean Leaves.
By Albert Charles Chibnall. *Biochem. J.*, 1924, XVIII, 387-394.

Investigations on the Nitrogenous Metabolism of the Higher Plants.
VI. The Role of Asparagine in the Metabolism of the Mature Plant.
By Albert Charles Chibnall. *Biochem. J.*, 1924, XVIII, 395-404.

Investigations on the Nitrogenous Metabolism of the Higher Plants.
VII. Leaf Protein Metabolism in Normal and Abnormal Runner-bean Plants.
By Albert Charles Chibnall. *Biochem. J.*, 1924, XVIII, 405-407.

Some Nitrogenous Constituents of the Juice of the Alfalfa Plant. I.
The Amide and Amino Acid Nitrogen.
By Hubert Bradford Vickery. *J. Biol. Chem.*, 1924, in press.

Some Nitrogenous Constituents of the Juice of the Alfalfa Plant. II.
The Basic Nitrogen.
By Hubert Bradford Vickery. *J. Biol. Chem.*, 1924, in press.

Pathogenesis of the Ocular Lesions Produced by a Deficiency of Vitamine A.
By Arthur M. Yudkin and Robert A. Lambert. *J. Exp. Med.*, 1923, XXXVIII, 17-24.

Changes in the Paraocular Glands Accompanying the Ocular Lesions which Result from a Deficiency of Vitamine A.
By Robert A. Lambert and Arthur M. Yudkin. *J. Exp. Med.*, 1923, XXXVIII, 25-32.

An Experimental Study of Ophthalmia in Rats on Rations Deficient in Vitamine A.
By Arthur M. Yudkin. *Arch. Ophthalmology*, 1924, in press.

Diseases of Connecticut Vegetables in 1923.
By G. P. Clinton. *Rept. Conn. Veg. Growers' Assn.* (1923) p. 45.

Injuries and Diseases of Connecticut Fruits in 1923.
By G. P. Clinton. *Rept. Conn. Pom. Soc.* (1923) p. 37.

Spraying Strawberries for the Control of Fruit Rots.
By E. M. Stoddard, D. H. Rose, and N. E. Stevens, U. S. Depart. Agr. Circ. 309, p. 1.

Will The Chestnut Trees Come Back?
By G. P. Clinton. *The New Eng. Farmer*, Vol. 49, p. 1.

Seed Notes.
By E. M. Stoddard. *Seed World*, Vol. 15, No. 11, p. 34; Vol. 16, No. 8, p. 31.

Report of Committee on Injurious Insects.
By W. E. Britton, Conn. Pom. Soc. *Proceedings* (1924) p. 41.

Some Insects to be Combated Next Season.
By W. E. Britton, Conn. Pom. Soc. *Proceedings* (1924) p. 72.

Insects Attacking Vegetable Crops in Connecticut in 1923.
By W. E. Britton, *Rept. Conn. Veg. Growers' Assn.* (1924) p. 43.

An Asiatic Beetle (*Anomala orientalis*) in Connecticut.
By W. E. Britton. *Jour. Econ. Ent.* (April 1924) Vol. 17, p. 309.

The Gipsy Moth and Our Forests.
By W. E. Britton. *New Eng. Farms* (June 21, 1924.)

Connecticut Tree Workers' Institute.
By W. E. Britton. *Florists' Exch.* (March 22, 1924), Vol. LVII, p. 890.

Proceedings, Shade Tree Conference.
By W. E. Britton. *Florists' Exch.* (Sept. 6, 1924), Vol. LVIII, p. 703.

Meeting of Connecticut Entomologists.
By W. E. Britton. *Jour. Econ. Ent.* (Dec., 1924), Vol. 17, p. 669.

Control of European Red Mite in Connecticut.
By Philip Garman. *Conn. Pom. Soc. Proceedings* (1924) p. 44.

Factors Influencing the Effectiveness of Arsenate of Lead.
By Philip Garman. *Florists' Exch.* (Sept. 6, 1924), Vol. LVIII, p. 685.

The Raspberry Fruit Worm.
By B. H. Walden. *Conn. Pom. Soc. Proceedings* (1924) p. 124.

Results of Dusting versus Spraying in Connecticut Apple and Peach Orchards in 1922.
By M. P. Zappe and E. M. Stoddard. *Crop Prot. Digest.* (June 1924), Bull. Series No. 4, p. 2.

Progress of Spraying and Dusting Experiments.
By M. P. Zappe and E. M. Stoddard. *Conn. Pom. Soc. Proceedings* (1924) p. 52.

Accomplishments in the Past Year in Anti-Mosquito Work in Connecticut.
By R. C. Botsford, N. J. Mosquito Exter. Assn. *Proceedings* (1924) p. 80.

Some Insect Information from a Connecticut Conference.
By W. E. Britton. *Florists' Exch.* (Nov. 29, 1924), Vol. LVIII, suppl. Page A.

Waxy Endosperm in New England Maize.
By P. C. Mangelsdorf. *Science* (Sept. 1924). Vol. 60, p. 222.

Selective Fertilization among the Gametes from the Same Individuals.
By D. F. Jones. *Proc. of the National Acad. Sciences* (June, 1924), Vol. 10, p. 218.

Methods for Seed Corn Production Being Revised.
By D. F. Jones. *Jour. Heredity* (July), 1924), Vol. 15, p. 291.

Heritable Characters of Maize (XII) Mealy Endosperm.
By P. C. Mangelsdorf. *Jour. Heredity* (Aug.-Dec., 1922), Vol. 13, p. 359.

The Inheritance of Defective Seeds in Maize.
By P. C. Mangelsdorf. *Jour. Heredity* (June, 1923), Vol. 14. p. 119.

Land Cover Studies as a Basis for a More Accurate Interpretation of the Soil Survey.
By M. F. Morgan. *Jour. Am. Soc. of Agron.* (July, 1924), Vol. 16, No. 7, p. 452.

PHYSICAL EQUIPMENT.

The removal of the Board of Health Laboratory to Hartford made available the lower floor and basement of the old Botany building, in which a very complete Soils laboratory has been installed. The small greenhouse has been repaired and will be used for pot experiments.

About 900 volumes were added to the library, which now contains 11,800 volumes.

REPORTS OF DEPARTMENTS.

ANALYTICAL CHEMISTRY.

Dr. E. M. Bailey in charge.

1. Control of Fertilizers. Eight hundred and eighty samples of commercial fertilizer have been analyzed, the results reported to the manufacturer and others interested, and the complete data classified and arranged for publication.

2. Inspection of Feeding Stuffs. Three hundred and fifty-two samples of commercial feeding stuffs and other fodder materials have been examined and the results published together with a discussion of the law relating to this subject.

3. Inspection of Foods and Drugs. Control and investigational work on food products and drugs has entailed the examination of about 1,800 samples.

4. Calibration of Babcock Glassware. Nearly 4,000 pieces of Babcock glassware have been checked for accuracy of calibration.

5. Inspection of Insecticides and Fungicides. About 70 samples of spraying and dusting materials were examined and the results published together with the text of the insecticide law recently enacted and rules and regulations for its enforcement as formulated jointly by the Director of this Station and the Dairy and Food commissioner.

6. Studies on Methods. Collaborative work has been carried on with the Association of Official Agricultural Chemists upon methods for the analysis of spices and other condiments and of cacao products.

7. Analysis of Diabetic Foods. The station has collaborated with the Council on Pharmacy and Chemistry of the American Medical Association on the subject of diabetic and special foods.

8. Analysis of Check Samples—Cottonseed Meal and Mixed Fertilizers. The Station has collaborated with the American Oil Chemists Society and the F. S. Royster Guano Co., in the analyses of check cottonseed meal and mixed fertilizers.

BIOCHEMISTRY.

*Dr. T. B. Osborne in charge.**(In collaboration with Dr. L. B. Mendel, Yale University.)*

PROTEIN RESEARCH AND NUTRITION STUDIES.

1. A Study of the Proteins of Green Plants. Investigations of the constituents of the alfalfa plant have been continued. New methods of fractionation have been developed and have indicated the presence in alfalfa juice of new substances, including a new base, not yet identified. A protein with no carbohydrate impurity

has been derived from cell cytoplasm of the spinach plant, by a new method of separation. Its isolation in a state of purity will be of importance in the study of the chemistry of the living cell.

2. The Relation of the Chemical Constitution of the Diet to the Development of Rickets. (With Dr. Park of the Yale School of Medicine.) Observations are being attempted under conditions of carefully controlled diet. Diets of purified food substances have been formulated which lead to the development of either rachitic or osteoporotic changes in the bones. It is inadvisable as yet to form generalizations from the extensive data collected.

3. Studies of the Relation of Vitamines to Nutrition. Experiments show that when smaller doses of protein-free vitamine B concentrate are fed to larger animals a decline in weight ensues; with intermediate doses there may be maintenance at various levels of body weight; with the larger vitamine B intake for the smaller animals growth ensues.

4. The Part Played by Proteins, Carbohydrates and Fats in Nutrition. (With cooperation of Drs. Park and Winternitz of the Yale School of Medicine.) The extent to which preformed carbohydrates are essential in metabolism, and the development of hypertrophy of the kidneys in protein-fed rats were further investigated. The success of varied types of experiments on diets extremely unlike those of every day experience seems to indicate that surprisingly large variations in the quantitative make-up of the diet may apparently be tolerated so long as the "law of minimum" is not violated.

5. The Effect on the Eye of a Deficiency of the Fat Soluble Vitamine. (With Dr. Judkin of the Yale School of Medicine.) It was found that ophthalmia occurs among rats living on "purified" Vitamine A free diets to a percentage as high as 82.

6. The Effect of Diet on Fertility. (With Dr. Mason of the Yale School of Medicine.) On our "standard" casein diet, which has proved adequate for growth but not for reproduction, definite degeneration of the germ cells of the testes of rats, reared from weaning on the casein diet, was recorded. Ordinary mixed diet has not restored sterile rats to a normal condition after periods of 100 days.

7. The Relation of the Chemical Structure of the Proteins to their Nutritive Value. Much remains to be learned concerning the part played in nutrition by the various amino-acids which proteins yield on digestion. As a preliminary to further study in this field much time has been devoted to preparing large quantities of pure amino-acids which can be used in feeding experiments.

BOTANY.

Dr. G. P. Clinton in charge.

1. The Effect of Fertilizers, Especially Nitrate of Soda, on the Growth, Yield, Longevity and "Yellows" of Peaches. Since it was started in 1909, records in this experiment have been kept on the health and length of life of each tree, of the growth in diameter of the trunk during the earlier years and of the yield from each during the bearing years. Since 1916 nitrate of soda has been the fertilization used on each of the nine different blocks.

Serious drought in July 1924, and later, a severe hail storm, practically ruined the season's crop. The chief causes of failures and poor crops have been winter and drought injuries, fungi and insects being secondary in importance.

2. The Nature and Cause of Mosaic Disease of Plants. The cause of mosaic disease still remains in doubt, altho interesting observations have been made, some of them apparently new. The experiment represents a continuation of work on Calico of Tobacco published several years ago, and is chiefly concerned with that host and the relationship of its mosaic to other hosts. The work of the past two years has been chiefly microscopic and with varied infectional experiments outdoors and in the greenhouse.

3. The Ustilaginales of North America. This is a supplement to the work the writer published some years ago. During the winter material was partially assembled but not completed. The work may be finished for publication during the coming year.

4. The Rusts of Connecticut. This is a list of the rusts, with their hosts, so far collected in this state. Their distribution is given by towns, together with the dates of collection, collectors, and occasional notes. Every town in the state is represented by one or more collections. Total collections now number more than 2,500, representing nearly 120 species and 20 genera. The manuscript for publication, including keys to the genera and species, has been partially prepared.

5. Plant Disease Survey of Connecticut. Altho a dry season was experienced, on the whole rather unfavorable for fungous diseases, the Disease Survey for 1924 includes more than the usual number of notes on distribution, etc. Two or three new bacterial diseases of economic plants were listed for the first time. Preliminary reports to the U. S. Bureau of Plant Industry have been made.

6. Thielavia Basicola, a Study of the Perfect Stage. Evidence has accumulated that the conidium-chlamydospore strains and the perithecial strains do not belong to the same fungus, altho the perithecia have been hitherto considered the perfect stage of *Thielavia basicola*. Successful crossings besides those

of *Thielavia basicola* and *Thielaviopsis basicola* have been made of asco strains with a species of *Aspergillus* and *Fusicladium pyrinum* as well as with *Cladosporium fulvum*. Crossings made with *Thielaviopsis paradoxa* failed to produce perithecia. Attempts to determine the parasitism of the asco strains have so far yielded negative results altho perithecia have been found deeply embedded in the roots of tobacco, pea and violet, but in these cases always associated with the conidium-chlamydospore stages.

7. A Study of Pythiums. Artificial cultures of various fungi are obtained and kept going on special media in the test tubes. These are then available for special study as desired. *Pythium* species obtained from about a dozen different hosts, chiefly as dampening-off fungi, are among those now being especially collected.

8. Comparison of Spraying and Dusting on Apples and Peaches, Especially to Try New Dusts. (Joint project with Entomological Department.) For fungi, spraying has uniformly given the better control. This year, however, the dust control more nearly approached the spraying because of dry weather which prevented the development of fungi. A test of spray and dust combination did not give marked results but it seems desirable to experiment further with combinations of spray and dust as this seems to be the way that dust may be used in the control of apple troubles.

9. Control of Celery Blights with Sprays and Dusts. During the past year tests were made in thirteen fields with eight different growers. Home-made 4-4-50 Bordeaux mixture was compared with Niagara Sulfodust and Niagara D25 Copper Dust, checks being kept in each test. Comparatively little blight injury occurred in the fields so that decisive results were not obtained. On the whole control and yields seem to point to the following order of the plots: (1) Bordeaux Mixture, (2) Copper Dust, (3) Sulphur Dust, (4) Check.

10. Control of Root Rot and Improvement of Sweet Corn by Seed Selection. This experiment was started in 1920 to determine if it was possible, by seed selection, to control root and ear rots of sweet corn grown for seed. A composite sample of seed selected from the best lines during the preceding four years was planted in comparison with unselected seed of the same strain and unselected seed of the same variety grown in the same locality from a different seed source. The selected seed gave a better stand and more even growth especially early in the season. The number of diseased ears did not differ greatly in the three plots, but the yields of selected seed were much greater. The selected seed has also shown a steady increase in average per cent of disease-free ears, determined by germination tests.

11. Comparison of Sprays and Dusts on Potatoes. (Joint project with Entomology Department.) Copper dust has been

compared with 4-4-50 Bordeaux mixture in this experiment. There has been no blight in three years but each year the sprayed plot has given greater yield than the dusted, and the dusted has been better than the check. The sprayed vines have shown less injury from tipburn and flea beetle injury and have lived longer than those in the dusted and check plots.

12. Seed Testing. This is one of the oldest lines of work of the Station and is largely routine in nature. Farmers, and others, wishing to know the germination and purity of seeds purchased, send them in for testing. Particular attention is paid to testing seed-corn for experimental purposes. At times special work is done on certain seeds. For example, grass and forage crop seeds were tested the past year to determine if their standard of purity and germination in this state compared favorably with that in other states, which seems to be the case as shown by the result of the tests.

13. Peach "Yellows." Started in connection with fertilizer experiments of peaches in 1908, this study has consisted, in part, of "Yellows" surveys in different orchards over a series of years. Budding and other infection experiments have also been carried on. No results have been published except general notes.

14. Musk Melons and Blight Resistance. Some time ago this experiment was carried on over a period of several years. It consisted in growing 100 so-called varieties for three years and in making studies on blight resistance, quality and yield with sprayed and unsprayed vines of a selected variety, Miller's Cream. The results have never been published and no recent work has been done; the fields of commercial growers have been visited from time to time.

15. Chestnut Blight. This subject was investigated and the results published some years ago. Renewed interest in the future of the chestnut in this state has induced the Botany and Forestry departments to take up some new phases of the subject in 1924. Surveys were made in several marked localities on the number of dead, diseased and free sprouts, seedlings and trees. Records will be kept and these plots examined again yearly. Seed was obtained and placed outdoors to grow seedlings, in part, for planting eventually under forest conditions, and, in part, for inoculation with old and new cultures of the blight.

16. White Pine Blister Rust. Two papers have already been published on this subject. Only a little infection work has been done during the past year. Considerable data has been obtained that has not been published. A final study may be made of assembled data during 1925 and the results published in the next report.

17. Infection Experiments and Other Studies with Rusts. Work along infection lines has been carried on in the past. Much of

this has been done with leaves in petri dishes. A bulletin (No. 260) on this work is now in press.

18. **Tobacco Diseases.** All field and observational work on tobacco is included under this general title. Field and greenhouse studies on black and red root rot and general notes on all tobacco troubles, including culture of the fungous ones, are the chief phases of investigation at present.

19. **Onion Diseases.** Work in the past has consisted of general notes on the troubles of this host, seed treatment for smut on infected seed, and spraying experiments against blast of the seed crop.

20. **Tree Diseases.** General forestry and shade tree work is covered in this project. A list by hosts, of all of the fungi that had been collected on either living or dead trees and their products, has been prepared. A general article on Fungous and non-Parasitic Diseases of the Ornamental Trees of Connecticut has also been written.

21. **Bud Inheritance on Yield of Peaches.** It is planned to start a young orchard with scions budded from the most prolific and healthy, as well as from the less prolific and healthy trees, which have been under observation during the past sixteen years at the Barnes Experimental Peach Orchard. This is to determine if bud selected trees from these two sources will continue to show the same differences in yields. This will indicate if it is more advantageous to select buds from high-bearing trees than to practice miscellaneous selection. Seed stock for the budding has already been grown.

22. **Influence of Root Grafts on Scions of Apples.** This is to determine the effect of root on scion (1) on Baldwin with respect to quality of fruit borne (2) on McIntosh to observe the effect of root on color of fruit. Scions will be taken from Baldwin trees that have borne good fruit on their own roots and will be placed on roots from trees that bear poor fruit. This operation will be duplicated with poor-fruited trees. The McIntosh striped and self-colored trees will be grown each on its own roots and on roots of the opposite color.

ENTOMOLOGY.

Dr. W. E. Britton in charge.

1. **The Life History, Habits and Control of the Plum Curculio on Apple.** Several new facts regarding the habits and life history of *Conotrachelus nenuphar* Hbst. have been learned during a study of two seasons in the five year program for the study and control of the plum curculio on apples. No satisfactory control methods have been ascertained, however.

2. **Tests of Paradichlorobenzene to Control the Peach Borer.** (Inactive.)

3. **Comparisons of Spraying and Dusting on Apples and Peaches, Especially to Try New Dusts.** (Joint project with Botany Department.) (See Botany.)

4. **Comparisons of Sprays and Dusts on Potatoes.** (Joint Project with Botany Department.) (See Botany.)

5. **The Life History, Habits and Control of the European Red Mite.** (Inactive.)

6. **Control of Foul Brood of Bees.** Testing denatured alcohols to obtain a satisfactory product for making Hutzelman's alcohol formalin solution, in addition to comb treatment with the commercial preparation for control of American foul brood, comprised the work during 1924.

7. **A Study of the Asiatic Beetle, *Anomala orientalis*.** A study of this beetle was undertaken following a severe infestation of New Haven lawns. Some progress has been made in life history studies. Calcium cyanide is effective in killing larvae of the beetle but it injures vegetation and is a menace to children and dogs. Carbon disulphide is more satisfactory.

8. **The Life History, Habits and Control of the Raspberry Fruit Worm.** (Completed.)

9. **Insect Survey of Connecticut.** For four years data has been gathered on the prevalence or absence of insect pests and monthly reports have been sent to the Federal Bureau of Entomology for publication in a bulletin covering conditions in the United States.

10. **Inspection of Orchards and Nurseries.** All nurseries (116 in 1924) were inspected for insect pests. The botanist, co-operating with the inspectors, searched for plant diseases. Forty-seven orchards and gardens were inspected on request.

11. **Control of the Gipsy Moth.** State scouts covered 73 towns. Federal scouts 35 towns in 1923-24. All of the 10,007 egg clusters found were creosoted, and 327 infestations were sprayed in May and June, using 8,483 pounds of lead arsenate. Around the infestations, 6,315 larvae were destroyed besides those killed by spraying. State scouts covered 6,975 miles of road.

12. **Elimination of the Mosquito Nuisance in Salt Marshes.** Under State supervision 5,000 acres of salt marsh were patrolled throughout the season and 154,000 lineal feet of ditches recut. Salt marsh areas in Stamford were reditched and new ditching is in progress in Westbrook. Ten new iron culverts and six new iron tide gates were installed. One dike was repaired.

13. **Inspection of Apiaries.** Among 953 apiaries, containing 8,929 colonies of bees, 17 apiaries (47 colonies) were found infested with European foul brood, and 10 apiaries (20 colonies) with American foul Brood. Directions and, in some cases, demonstrations, were given the owners regarding control.

14. **A Study of the Chemical Changes in Standard Spray Mixtures.** (Joint project with Chemical Department.) Tests of the effect which the order of mixing various ingredients has upon color, character of sediment and suitability for spraying of the spray mixture and also analyses of various combinations for water soluble arsenic to determine which combinations are best from a chemical standpoint, have yielded results which must be verified by additional chemical study.

15. **Bionomics of the Birch Leaf Skeletonizer, *Bucculatrix canadensisella*.** The main points in the life history have been worked out and several parasites uncovered. Work has been started on fungous diseases. Some features of morphology have been established and control measures determined. The distribution of the insect in Connecticut has been partly surveyed.

16. **Experiments with Baits Attractive to the Cabbage Maggot Fly.** The residue left from distilling an alcoholic extract of cabbage was found to be attractive when in suitable medium. This has been compared with other baits and is being developed as an efficient control measure.

17. **Life History and Methods of Controlling the Oriental Peach Moth, *Laspeyresia molesta*.** Threatening outbreaks late in the season of 1923 led to control studies in which nicotine dusts and sprays were tried with 50% control. A limited number of observations have been made on the life history in Connecticut and a general, observational survey of the State, supplemented with information from questionnaires sent to various growers, has been made.

18. **Life History of Imported Current Worm.** Data has been collected on egg laying habits, number of eggs laid by individuals, period of incubation, etc. Adults appeared two to three weeks late in 1924 and there were apparently only two broods.

19. **Control of the European Corn Borer.** Federal men scouted all towns along the shore, also Orange and Wethersfield and found seven infestations. State scouts covered four towns. All infested fields and some adjoining fields were burned over.

FORESTRY.

Mr. W. O. Filley in charge.

1. **Experimental Plantations on a Sandy Tract at Rainbow.**

- a. Comparison of a wide variety of conifers and hardwoods.
- b. Methods of management for those species that have survived.
- c. Studies on growth and habits of the several species. These were begun in 1902. In 1924 liberation cuttings and cleanings were completed where needed, fire lines were harrowed and new plantations were started to replace discontinued or unsuccess-

ful experiments. New experiments include under-planting of red oak with red pine; plantations of white spruce and red pine in the open and replanting a burned area with white pine. A report covering the results to date is now in press. (Bul. 262.)

2. Effect of Thinning in White Pine (At Shaker Station)—Three Grades of Thinning.

Students from the Yale Forest School made a second thinning in two of the plots in the spring of 1924.

3. Effect of Thinning in Hardwoods (At Quassipaug Lake). The plots were visited in connection with other work but no measurements were taken and none are planned until 1927.

4. Studies on White Pine Needle Blight. No definite observations were made during the year, the season apparently not being conducive to this trouble.

5. Distribution of Planting Stock to Small Holders at a Reasonable Price. The department again assisted land owners in securing forest planting stock. A total of 775,000 trees, mostly two year seedlings, were distributed on 95 orders.

6. Willow Culture (for Basket and Furniture Manufacture). One holt was discontinued and the roots pulled up. Preparations were made to distribute a large number of cuttings but only two requests were received and only 1,000 cuttings were sent out for the cost of packing and postage. Distribution will be continued and plantings already made will be visited.

7. Control of White Pine Blister Rust (a Control Project). Wild currant and gooseberry bushes were eradicated from 6,000 acres in the towns of Canaan, Cornwall, North Canaan, Litchfield and Salisbury. About 20% of the cost was paid by town appropriations or private subscriptions. Educational work was carried on co-operatively with the Federal Bureau of Plant Industry by two field agents employed throughout the year. New Haven and Fairfield Counties have been covered and scouting in Litchfield County is practically completed. Eradication and educational work will be continued.

8. Studies of Forest Plantations (Listing All Plantations and Taking Notes on Conditions, Success, Etc.). Blister rust agents have reported on more than 7,500 acres of plantations in 81 towns, but the studies are not yet completed. During 1925 the reports of plantations will be checked and additional studies made, with the plan of publishing a bulletin on forest planting before the close of the year.

9. Replacing Chestnut with Conifers in a Farm Woodlot. Planted evergreens have in most cases made good growth. Another cleaning will be necessary in 1925 and it may be desirable to remove more of the overwood.

10. Forest Soils Study. On 116 plots, for which the soil series and type have been determined, the following data has been recorded: (1) Locality, slope, aspect, site, quality, fires, silvicultural

treatment, (2) Forest cover (main stand) tallied on 1/20 acres by species, diameter and crown class, (3) Reproduction tallied on 1/100 acre by species and by height classes, (4) Shrubby under-growth noted as abundant, medium or scant for the 1/20 acre, (5) Herbaceous growth noted similarly to (4). No definite conclusions have been formulated from the assembled data, and plans for the coming year must await the derived results. More plots will probably be necessary to make proper correlations.

11. **Coniferous Seed Bed Study to Determine:**

1. The value of fertilizers in seed beds.
2. The value of different amounts of seed.
3. The value of dusts and sprays in preventing damping off.

Thirteen seed beds were laid off on the Station grounds and were treated as outlined above. The experiment will be continued and data recorded.

GENETICS (PLANT BREEDING.)

Dr. D. F. Jones in charge.

1. **The Inheritance of Characters in Corn.** The widespread occurrence of lethal factors producing aborted and defective grains in corn has been determined and the effect of these factors upon development is being studied as well as their mode of inheritance. A number of factors influencing the development of the floral organs and affecting the fertility of the corn plant have been located.

2. **The Effect of Inbreeding and Crossing Upon Corn.** Four inbred strains of corn self-fertilized for eight generations were separated into two lines each and continued for eight generations more. Two of these four paired lines were visibly different at the end of this period and all gave significant increases in growth when the paired members were intercrossed.

3. **Methods for the Improvement of Naturally Cross-Fertilized Plants by Selection in Self-Fertilized Lines.** Preliminary crosses were made between the most promising selected lines of Evergreen sweet corn. Crosses between various lines of early maturing dent and flint corn were grown from which a type for grain in Connecticut will be developed. Seventy-five lines of Whipple's Early Yellow Sweet Corn were started for the purpose of producing an early medium-sized yellow sweet corn of good quality for market gardeners.

4. **Methods of Improving the Naturally Self-Pollinated Tobacco Plant.** Forty-two selections from a cross of Cuban and Broadleaf tobacco have been grown. These include lines which have been one, two or three times back-crossed with Cuban. These are being selected as a shade type and being studied to determine to what extent the shade tobacco characteristics can be retained with added improvements from the other type.

SOILS.

Mr. M. F. Morgan in charge.

1. Utilizations and Fertilizer Requirements of Important Soil Types of Connecticut. Previous intensive studies of soil conditions and land utilization in Lebanon yielded data which was studied in relation to the economic survey conducted by the department of Rural Economics of the Connecticut Agricultural College. It was found that, in the above town, the area in which the Charlton series of soil occurred, was markedly superior as a dairy region to the other portions of the town where Gloucester fine sandy loam, Gloucester stony fine sandy loam and the Merrimac series were the principal soils. Interesting relationships of soils to land cover were also manifested.

These results having shown the necessity for further study in regions where somewhat different soil conditions occurred, the areas of Wilton, Goshen, Middletown, Pomfret, Eastford and Stonington were surveyed during the field season. The use of airplane photographs materially aided the study of land utilization and accurate mapping of soil type areas in the town of Middletown.

A lack of uniformity of soil conditions was found in the areas studied during the 1924 field season but certain soil types were shown to be fairly constant in their characteristics wherever found.

Land utilization studies as tabulated thus far bear out the fact that soils such as the Gloucester stony fine sandy loam, are of value chiefly for forestry and recreational sites, those similar to the Charlton loam are particularly adapted to dairying; while soils like the Merrimac sandy loam are peculiarly adapted to potatoes, intensive trucking and vegetable gardening.

The need for a thorough soil and land utilization survey becomes more and more apparent as the results of the present studies are considered.

Sub Project A—Soil Survey and Land Cover Studies of Selected Areas in Connecticut. This project has taken three phases of development: (1) Completion of maps and data incident to the soil-land cover and economic survey of Lebanon town, (2) Detailed land cover and soil type studies in the towns of Wilton, Goshen, Middletown, Pomfret, Eastford and Stonington, (3) Tabulation of data on these areas to show distribution of cover on the more important soil types.

Sub Project B—Pot Experiments on Effects of Fertilization of Important Soil Types. Pot experiments with 12 soil types of Connecticut, using alfalfa and buckwheat to show the effects of Lime, Nitrogen and Phosphorus, and these plus Potassium, show wide differences in fertility of untreated soils and in relative

responses to treatment. Sixteen samples of soil have been collected for further experiment.

Sub Project C—Soil Reaction Studies. Samples of various horizons of most of the soil types represented in each area studied in sub-project A have been collected for studies in lime requirement, h-ion concentration, and soluble aluminum compounds.

Sub Project D—Mechanical Analyses of Important Soil Types. Similar samples have been collected for this experiment in determination of mechanical analyses by U. S. Bureau of Soils and Harlan Jonson's method, and determination of colloidal material.

Sub Project E—Studies of Forest Adaptations of Important Soil Types. This experiment has two phases: (1) Identification of soil types on plots upon which forestry department made detailed studies of stands and associations, (2) Collections of seven soil types upon which studies are to be made of growth of seedlings of forest species in pot experiments.

Sub Project F—Chemical Analyses and Reaction Studies of Particular Pasture Soils. Soil samples have been collected from 25 pasture demonstration fields located in various parts of the state to determine the total Nitrogen, Phosphorus, Potassium, Calcium and Magnesium and the reaction of all samples.

TOBACCO SUB-STATION AT WINDSOR.

The sudden resignation of Mr. C. M. Slagg on March 1, made necessary a restriction of the Service work possible during the season of 1924. The experimental program, however, went forward without interruption. A very elaborate new project was launched, having as its object the improvement of the several types of Broadleaf and Havana now recognized among growers. A large number of so-called strains of each type were grown at Windsor and on plots scattered about the various type districts. These will be continued next year. Experiments under way may be listed:

1. Fertilizer Experiments
 - a. Sources of Nitrogen.
 - b. Ratio of Phosphoric Acid.
 - c. Sources of Potash.
 - d. Fractional Applications.
 - e. Manure (New York and cow (steer) compared with none).
 - f. Magnesium, Chlorine and Sulfur. (U. S. D. A.).
2. Varietal Improvement
 - a. Strain trials of Broadleaf, Havana and Cuban as a basis for future improvement.

- b. Tests of crosses made by Dr. Jones.
- c. Round tip cultural experiments to improve quality.
- d. Trials for "foreign" or new types.
- e. *N. rustica* as a source of nicotine.

3. Curing Experiments.
Lack of land for growing material prevented the carrying out of these as planned.

4. Diseases.

- a. Tests of Control Measures for Wildfire.
- b. Brown Root Rot (U. S. D. A.).
- c. Black Root Rot, the effect of soil treatments.

Except as noted, the above program was carried out in spite of the fact that the position of superintendent was not filled. The weather was extremely dry and a partial crop failure resulted. At this time it is too early to estimate the results, the crop not being sorted.

A Field Day was held at the farm on August 5, about 400 persons attending. An excellent lunch was served by the ladies of a local church. A program for the day, held in the new shed, was a unique feature.

List of Publications Available for Distribution.**CROPS**

- 150. Clover Seed in the Connecticut Market
- 180. Studies on the Tobacco Crop of Connecticut
- 191. Tests of Soy Beans, 1915
- 192. Observations on Alfalfa
- 193. Tests of Soy Beans, 1916
- 228. Connecticut Round-Tip Tobacco
- 259. Corn in Connecticut

FEEDING STUFFS

- 138. Commercial Feeding Stuffs in the Connecticut Market
- 141. Commercial Feeding Stuffs in the Connecticut Market
- 206. Report on Commercial Feeding Stuffs, for 1917
- 212. Report on Commercial Feeding Stuffs, for 1918
- 221. Report on Commercial Feeding Stuffs, for 1919
- 229. Report on Commercial Feeding Stuffs, for 1920
- 238. Report on Commercial Feeding Stuffs, for 1921
- 249. Report on Commercial Feeding Stuffs, for 1922
- 257. Report on Commercial Feeding Stuffs, for 1923

FERTILIZERS

- 156. Cotton Seed Meal As a Fertilizer
- 170. The Trade in Cotton Seed Meal
- 194. Manure from the Sea
- 198. Domestic Supplies of Potash
- 204. Report on Commercial Fertilizers, for 1917
- 209. Report on Commercial Fertilizers, for 1918
- 217. Report on Commercial Fertilizers, for 1919
- 223. Report on Commercial Fertilizers, for 1920
- 233. Report on Commercial Fertilizers, for 1921
- 241. Report on Commercial Fertilizers, for 1922
- 250. Report on Commercial Fertilizers, for 1923

FOOD AND DRUG PRODUCTS

- 200. Report on Food and Drug Products, for 1917
- 210. Report on Food and Drug Products, for 1918
- 219. Report on Food and Drug Products, for 1919
- 227. Report on Food and Drug Products, for 1920
- 236. Report on Food and Drug Products, for 1921
- 248. Report on Food and Drug Products, for 1922
- 255. Report on Food Products and Drugs, for 1923

FOODS

- 201. Food Fats and Oils
- 213. Condensed Milk, Malted Milk, Milk Powder
- 215. The Food Value of Milk
- 220. Report on Diabetic Foods
- 240. Commercial Vitamine Preparations

FORESTRY

- 231. Report of the Tree Protection Examining Board
- 253. Better Forests for Connecticut

INSECTS

155. The Elm Leaf Beetle
 169. The Leopard Moth
 177. The Apple Tree Tent Caterpillar
 182. The Brown-Tail Moth
 186. The Gypsy Moth
 195. Insects Injuring Stored Food Products in Connecticut
 203. Report of the Entomologist, for 1917
 211. Report of the Entomologist, for 1918
 218. Report of the Entomologist, for 1919
 225. A Study of the Bulb Mite.
 226. Report of the Entomologist, for 1920
 230. The Grass-Feeding Frog-Hopper or Spittle-Bug
 231. Report of the Tree Protection Examining Board
 242. Report on Commercial Insecticides and Fungicides, 1922
 245. Results of Dusting vs. Spraying in Connecticut Apple and Peach
 Orchards in 1922
 246. The Apple and Thorn Skeletonizer
 247. Report of the Entomologist, for 1922
 251. The Raspberry Fruit Worm
 252. The European Red Mite
 256. Twenty-third Report of the State Entomologist (1923)
 258. Report on Insecticides and Fungicides (1923)

PLANT DISEASES

214. Report of Botanist, for 1917 and 1918
 222. New or Unusual Plant Injuries and Diseases Found in Connecticut
 1916-1919
 231. Report of the Tree Protection Examining Board
 237. Control of the White Pine Blister Rust in Connecticut
 239. Wildfire of Tobacco in Connecticut
 242. Report on Commercial Insecticides and Fungicides, 1922
 245. Results of Dusting vs. Spraying in Connecticut Apple and Peach
 Orchards in 1922
 258. Report on Insecticides and Fungicides (1923)

POULTRY

202. An Experience in Keeping Poultry in the City

REPORTS OF DIRECTOR

232. Report of the Director for the Year Ending October 31, 1921
 243. Report of the Director for the Year Ending October 31, 1922
 254. Report of the Director for the Year Ending October 31, 1923
 264. Report of the Director for the Year Ending October 31, 1924

REPORTS

Beginning with the year 1877 and ending with 1916 the Station issued Annual Reports. Of these the following are out of print: 1877-1880 inclusive, 1882, 1883, 1885, 1886, 1887, 1889-1892 inclusive, 1895-1906* inclusive.

Commencing with the year 1917, the annual reports include all regular bulletins; they are issued in parts and each part bears a bulletin number.

*Of some other reports the Station has but a limited number, which are reserved to complete library sets.

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